PERCEPTUAL FACTORS IN BRAILLE WORD RECOGNITION

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Perceptual Factors in Braille Word Recognition

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Since the beginning of 1960, Cleves Kederis and I at the American Printing House have been studying the perceptual processes involved in the tactual recognition of braille words. To this time, fourteen studies related to this problem have been completed. Our studies in this area, to a great extent, are analogous to the types of studies that have concerned perceptual factors in print reading.

Print reading studies, which are extensive, have taken a variety of forms. For example, photographic studies of eye movements during reading have revealed that the eyes move irregularly with brief fixations and that perception occurs during the fixation periods. Tachistoscopic studies of the behavior of skilled print readers have shown that groups of letters, words and groups of words are recognized at the same amount of exposure as required for individual letters of the alphabet. Other rapid exposure studies of word recognition have identified certain stimulus characteristics which affect word perception. The general conclusion from this research has been that familiar words are perceived as wholes by means of their total structure under the influence of certain characteristics of their components. It is from this source that the concept of "whole word" reading stems.

In the case of braille reading, while it has not been explicitly demonstrated, it does seem to be assumed by many that tactual reading proceeds in a manner similiar to print. One educator has written (1) "The children soon learn the shapes of words and

groups of words and later recognize them as whole words." Another says (2) "Most (blind) children, however, learn rather quickly to recognize words as wholes by their shapes...." The number of such statements appearing in the tactual reading literature gives evidence of considerable agreement among educators on this question.

It was within this framework that the research described in this paper originated. Its purpose was to study perceptual factors in braille word recognition in order to more clearly delineate the cues that make braille whole word recognition possible. Knowledge of the factors important to perception in braille reading could have wide application in design of instructional methods, refinement of remedial reading techniques and, possibly, development of training programs for increasing braille reading speeds.

The procedure used in most of our studies has followed the same general pattern. Subjects have been high school students. They have been selected from the upper and lower thirds of the distribution for reading speeds at these grade levels. However, only subjects who comprehended at a relatively high level were selected. Participants in the experiments were required to recognize braille words and characters under conditions of controlled time of exposure. The words were first exposed for time intervals below those necessary for recognition. Then exposure times were systematically increased until the subjects were correctly able to identify the stimulus. The basic data for the studies consist of recognition thresholds for the braille words and characters and of the errors made by the subjects prior to recognition.

As you might guess, the findings of our studies are quite extensive. One thing that our findings do is to reveal the great complexity of the braille reading process. Many things determine the time of exposure necessary for tactual word recognition. For example, the time required to read words increases as words become longer and as words decrease in familiarity. Words with many dots occurring in the lowest row of the braille cell take longer to recognize than words with fewer dots in this position. Words containing contractions are more difficult to recognize than words without contractions. The more contractions a word contains the longer it takes to recognize it. These factors combine to augment the effects of one another.

As was just mentioned, the time required for tactual recognition of words is positively related to the number of characters they contain. Inseveral of our studies, we have determined the length of time necessary to recognize the individual braille characters contained in our stimulus words. When we compare the time necessary to recognize a word with the sum of the times required to recognize the characters it contains, we generally find that the word recognition time is longer. This is, of course, opposite to findings for regular print reading.

This evidence leads us to believe that the perceptual unit in braille word recognition is not the whole word shape, but is the individual braille character. The process of word recognition appears to be a sequential integrative one in which word recognition is the result of the accumulation of pieces of information over a temporal interval. Generally speaking, the braille reader accumulates

information as he moves from cell to cell, some integration of this information is made as this sequence occurs, and, often a significant amount of time is required after the last character is sensed before all the information is integrated to arrive at a word percept. This process is most obvious in the reading of unfamiliar words.

That there are exceptions to this general conclusion should be apparent immediately. In many instances in our studies readers identified words correctly before they had touched all the characters the word contained. This happening rarely occurred with words of three characters or among any unfamiliar words. However, as the number of characters in words increased, the probability of recognition before all characters were sensed also increased. The explanation for this phenomenon very likely is that the skilled braille reader employs a far greater variety of cues in word recognition than is directly available from the braille characters themselves.

As in the case for other perceptual activities, word recognition appears to be based on a probabilistic model of the braille reading environment. In other word, in the course of developing skill the reader learns that certain things tend to follow one another and utilizes these relationships in word recognition. Evidence for probability learning exists even at the level of simple character recognition. In our research, we have exposed individual braille characters at times that were too short for most readers to recognize them. Reader identifications of characters under these conditions mostly were wrong. However, the erroneous character named was more often one that appears very frequently in reading and less

often one that occurs more rarely. The rule seems to be, when in doubt about what you see, you have a better chance of being correct if you name a character that appears quite frequently.

Other more complex cues than simple frequency of character occurence are available to the tactual reader. The relative probability of one letter following another can be a cue. For instance, whenever we encounter the letter "q", the chances are extremely great that the next letter we see will be "u". Experience with the frequency of occurence of sets of letters can provide cues for word recognition. The occurence of prefixes and common stems in the English language restricts the possibilities of certain letters or letter combinations following. Therefore as more letters of a word are encountered, the probability for correctly guessing the word is increased.

The context in which a word occurs provides many cues as to its meaning. In our studies, we have found that placing a familiar word within a meaningful context reduces the amount of time required for its recognition. While this effect does not occur for words of three characters, it is apparent in the case of five character words and pronounced in the case of seven character words. Un~~l~~der the conditions of our studies, it was interesting to observe that while context helped in the recognition of familiar words, it interfered with the recognition of unfamiliar words. In the case of the latter, it appears that skilled readers, relying habitually on cues derived from preceeding context and information derived from sensing the initial parts of words tend to perceive the stimulus as likely a familiar word. Since in our experiments we have stacked the deck

by changing the relative probability of occurence of familiar and unfamiliar words, their probabilistic perceptual model is no longer valid. This leads to a higher frequency of erroneous perceptions for unfamiliar words.

It was mentioned earlier that our high school subjects were selected from the upper and lower thirds of the distribution for reading speeds in such a manner that both groups have equal and high amounts of comprehension. We have named these groups fast and slow readers. When compared, fast and slow groups selected in this manner are equivalent in age, grade level and distribution of sexes. They do not differ on measures of tactual discriminatory ability. Groups selected in this fashion do differ in IQ, the mean for the fast groups being about 120 and that for the slow groups being about 100.

When the reading behavior of these groups is compared, the following appears. Estimated mean reading speed for fast groups is about 130 wpm and about 65 wpm for slow groups. It takes about twice as long for the slow readers to recognize individual braille characters as it does for fast readers. Word recognition times are from 60-100% greater for slow readers. While the dynamics of the braille reading process appear the same for the two groups, increases along any of the word dimensions studied (length, familiarity, contracted-uncontracted) results in a disproportionate increase in word recognition times for the slow groups. Context helps less in recognizing familiar words and hinders recognition of unfamiliar words to a much greater degree for slow readers as compared to fast. Slow readers recognize many fewer words before all the characters are

sensed than do fast readers.

Although the descriptive data for the groups are meagre, the fact that IQ is the sole measure on which they differ stimulates this kind of speculation. The groups are equal in comprehension but vastly different in rate. Rate of braille reading may therefore be highly related to the intelligence of the reader. If the braille character is assumed to be the perceptual unit in reading, then the associative integrative burden of the braille reading process can be assumed to be far greater than that for print. If this is the case, a higher minimum intelligence may be required to learn to read the braille system or to develop a degree of skill to read it with any facility than has generally been assumed.

The results of our research to date provide literally dozens of directions for additional research in the area of tactual reading. We are reaching the point where implications for reading instruction are becoming apparent.

It is not possible to explore these implications in the time allotted to this paper. However, the paper by Miss Henderson describes a pilot study to explore one lead in the area of reading instruction.